

Table of Contents

Building Information Modeling

| BIM Design Coordination Room Infrastructure: Assessment of Communication Activities M. R. A. Addor and E. T. Santos | 1 |
|----------------------------------------------------------------------------------------------------------------------|----|
| Social Involvement to Empower a Better BIM Content Library | 2 |
| R. Fu and J. Zhang | _ |
| Interoperability between Building Design and Building Energy Analysis | 3 |
| Elizabeth Guzmán and Zhenhua Zhu | |
| Modeling Spatial Compositions with Network-Based Spaced Layouts | 4 |
| G. Suter | |
| Practice vs. Prescription—An Examination of the Defined Roles in the NZ BIM Handbook | 5 |
| K. Davies, D. McMeel, and S. Wilkinson | |
| BIMCloud: A Distributed Cloud-Based Social BIM Framework for Project Collaboration | 6 |
| Moumita Das, Jack C. P. Cheng, and Srinath Shiv Kumar | |
| The Development of a Framework for a Design for Safety BIM Tool | 7 |
| Graham Hayne, Bimal Kumar, and Billy Hare | |
| Supporting Tunnel Safety Assessment with an Information Model | 8 |
| N. Vossebeld and T. Hartmann | |
| Building Information Modeling for Quality Management in Infrastructure Construction Projects | 9 |
| Namhun Lee, Talat Salama, and George Wang | |
| Using Effort Distribution Analysis to Evaluate the Performance of Building Information | 10 |
| Modeling Process | |
| A. A. Aibinu, P. de Jong, H. Wamelink, and A. Koutamanis | |
| Robust NURBS Surface Fitting from Unorganized 3D Point Clouds for Infrastructure As- | 11 |
| Built Modeling | |
| Andrey Dimitrov and Mani Golparvar-Fard | |
| Synchronous Building Information Model-Based Collaboration in the Cloud: A Proposed | 12 |
| Low Cost IT Platform and a Case Study | |
| J. Munkley, M. Kassem, and N. Dawood | |
| Enriching the "I" in BIM: A BIM-Specifications (Bimspecs) Approach | 13 |
| E. Utiome, R. Drogemuller, and M. Docherty | |
| A Combined Planning and Controls Approach to Accurately Estimate, Monitor, and | 14 |
| Stabilize Work Flow | |
| David Grau, Amin Abbaszadegan, Pingbo Tang, Ram Ganapathy, and Jose Diosdado | |
| Updating R-Values of BIM Elements using 3D Thermography for Accurate Building | 15 |
| Energy Performance Simulation | |
| Youngjib Ham and Mani Golparvar-Fard | |

| BIM-Enabled Decision Making for In-Building Rescue Missions | 16 |
|----------------------------------------------------------------------------------------|----|
| Albert Y. Chen and Ting Huang | |
| Creating the Dutch National BIM Levels of Development | 17 |
| L. A. H. M. van Berlo and F. Bomhof | |
| Visualization of Design, Organization of Construction and Technological Solutions | 18 |
| B. V. Zhadanovsky and S. A. Sinenko | |
| Achieving Level 2 BIM by 2016 in the UK | 19 |
| A. A Ganah and G. A John | |
| Exploring the Need for a BIM Governance Model: UK Construction Practitioners' | 20 |
| Perceptions | |
| Eissa Alreshidi, Monjur Mourshed, and Yacine Rezgui | |
| Principal Component Analysis to Investigate the Effect of BIM Use on AEC Project | 21 |
| Changes | |
| Tober C. Francom and Mounir El Asmar | |
| Contractors' Perception of the Factors Affecting Building Information Modelling (BIM) | 22 |
| Adoption in the Nigerian Construction Industry | |
| M. Abubakar, Y. M. Ibrahim, D. Kado, and K. Bala | |
| IT Barometer Survey in Luxembourg: First Results to Understand IT Innovation in | 23 |
| Construction Sector | |
| Sylvain Kubicki and Conrad Boton | |
| Studying the Status of Variations in Construction Contracts in Jordan | 24 |
| Ghanim A. Bakr | |
| Embedding Cultural Knowledge in Building Information Modeling (BIM) for Fabrication | 25 |
| Efficiency to Reduce Industrialized Construction Waste | |
| M. Abdul Ghafar, R. Ibrahim, and Z. Shari | |
| Quantifying the Environmental, Social, and Economic Value of Educational Building | 26 |
| Projects using BIM Data | |
| Lu Zhang and Nora M. El-Gohary | |
| A Test Bed for Verifying and Comparing BIM-Based Energy Analysis Tools | 27 |
| Yu-Hsiang Wen, Han-Jung Kuo, and Shang-Hsien Hsieh | |
| A BIM Extension for Sustainability Appraisal of Conceptual Structural Design of Steel- | 28 |
| Framed Buildings | |
| A. H. Oti, W. Tizani, and A. Jaly Zada | |
| A Framework for a Building Energy Model to Support Energy Performance Rating and | 29 |
| Simulation | |
| Jamal A. Abdalla and Kincho H. Law | |
| Streamlining the Value Engineering Process and its Impact on Building Energy | 30 |
| Performance | |
| V. Bazjanac, T. Maile, J. T. O'Donnell, S. Tarantino, N. Mrazović, and J. Compostella | |

| A Study to Support BIM Turnover to Facility Managers for Use after Construction | 31 |
|-----------------------------------------------------------------------------------|----|
| Timothy Justin Brooks and Jason D. Lucas | |
| Issues in Decision Support Tools for Sustainable Infrastructure Management | 32 |
| Thomas M. Froese and Dana J. Vanier | |
| An Integrative Process for Advanced Energy Retrofit Projects | 33 |
| Sreelatha Chunduri, Sanghoon Lee, and John I. Messner | |
| Visualization of a Fire Risk Index Method with Combined Deferred Maintenance Cost | 34 |
| Estimation within a BIM Environment | |
| Kristian Schatz and Uwe Rüppel | |
| BIM and Australian Green Star Building Certification | 35 |
| S. Gandhi and J. Jupp | |
| Sustainable Construction Approach through Integration of LCA and BIM Tools | 36 |
| Joaquín Díaz and Laura Álvarez Antón | |
| BIM—Visualization and Simulation | |
| BIM-and Simulation-Based Site Layout Planning | 37 |
| H. Astour and V. Franz | |
| Changing Scheduling Purposes and Evolving 4D-CAD Models: A Study of Planning and | 38 |
| Realization in a Utility Project | |
| L. L. olde Scholtenhuis and T. Hartmann | |
| Integration of Safety Risk Factors in BIM for Scaffolding Construction | 39 |
| Rachel Collins, Sijie Zhang, Kyungki Kim, and Jochen Teizer | |
| Visualization in 4D Construction Management Software: A Review of Standards and | 40 |
| Guidelines | |
| Fadi Castronovo, Sanghoon Lee, Dragana Nikolic, and John I. Messner | |
| A Framework Design for Optimizing Scaffolding Erection by Applying Mathematical | 41 |
| Models and Virtual Simulation | |
| Lei Hou, Changzhi Wu, Xiangyu Wang, and Jun Wang | |
| Representing Requirements of Construction from an IFC Model | 42 |
| K. W. Yeoh and David K. H. Chua | |
| GIS-BIM Based Virtual Facility Energy Assessment (VFEA)—Framework Development | 43 |
| and Use Case of California State University, Fresno | |
| Wei Wu, Xiaoming Yang, and Qin Fan | |
| Drywall State Detection in Image Data for Automatic Indoor Progress Monitoring | 44 |
| C. Kropp, Ch. Koch, and M. König | |
| Simulating and Visualizing Construction Operations using Robot Simulators and | 45 |
| Discrete Event Simulation | |
| Joseph Louis, Phillip Dunston, and Julio Martinez | |

| Multi-Sample Image-Based Material Recognition and Formalized Sequencing Knowledge | 46 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| for Operation-Level Construction Progress Monitoring | |
| Kevin K. Han and Mani Golparvar-Fard | |
| Integration of BIM and Lean Concepts to Improve Maintenance Efficiency: A Case Study | 47 |
| Wenchi Shou, Xiangyu Wang, Jun Wang, Lei Hou, and Martijn Truijens | |
| Qualitative and Quantitative Cost Estimation: A Methodology Analysis | 48 |
| S. Aram, C. Eastman, and J. Beetz | |
| BIM—Design and Analysis | |
| An Industry Foundation Classes (IFC) Web-Based Approach and Platform for Bi- | 49 |
| Drectional Conversion of Structural Analysis Models | |
| Xiao-Yang Zhang, Zhen-Zhong Hu, Heng-Wei Wang, and Mohamad Kassem | |
| Damage Assessment, Cost Estimating, and Scheduling for Post-Earthquake Building | 50 |
| Rehabilitation Using BIM | |
| Georgiou Charalambos, Vamvatsikos Dimitrios, and Christodoulou Symeon | |
| Automatic Generation of As-Built Geometric Civil Infrastructure Models from Point Cloud | 51 |
| Data | |
| G. Zhang, P. A. Vela, and I. Brilakis | |
| Integration of Computer-Aided Solar Energy System Design in Building Information | 52 |
| Modeling | |
| Hung-Ming Chen and Yi-Fan Ger | |
| Project Cost Estimation of National Road in Preliminary Feasibility Stage Using BIM/GIS | 53 |
| Platform | |
| T. Park, T. Kang, Y. Lee, and K. Seo | |
| Towards an Integrated Grid- and Cloud-Based Structural Analysis Platform | 54 |
| M. Polter, A. Ismail, and R. J. Scherer | |
| BIM—Collaborative Design and Engineering | |
| | |
| A Framework for Integrating Change Management with Building Information Modeling | 55 |
| Fangxiao Liu, Abdou Karim Jallow, Chimay J. Anumba, and Dinghao Wu Use of Building Information Modeling for the Design and Construction of Educational | 56 |
| Facilities | 30 |
| | |
| C. Moreno, S. Olbina, and R. Issa | |
| On-Site BIM Model Use to Integrate 4D/5D Activities and Construction Works: A Case | 57 |
| Study on a Brazilian Low Income Housing Enterprise | |
| S. Scheer, R. Mendes Jr., T. F. Campestrini, and M. C. Garrido Civil Information Modeling Adention by Jove and Misseyri DOT | EO |
| Civil Information Modeling Adoption by Iowa and Missouri DOT | 58 |
| Fangyu Guo, Yelda Turkan, Charles T. Jahren, and H. David Jeong | |

| Characterizing Collaborative 4D Use Contexts to Improve Interaction Mechanisms Design | 59 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Conrad Boton, Gilles Halin, and Sylvain Kubicki | |
| Study of Digital Lean Construction Platform for Precast Components | 60 |
| Li Yungui, Qiu Kuining, Wei Yongbin, and Zeng Tao | |
| BIM-Based Plan Modeling System at Preliminary Stage for Residential Real Estate | 61 |
| Projects | |
| Tianfeng He, Jiarui Lin, Zhenzhong Hu, Jianping Zhang, Weidong Jia, and Jing Su | |
| Trends of Assessing BIM Implementation in Construction Research | 62 |
| Hamid Abdirad and Pardis Pishdad-Bozorgi | |
| Open BIM-Based Information Modeling of Railway Bridges and its Application Concept | 63 |
| SH. Lee, S. I. Park, J. Park, and KW. Seo | |
| Building Information Modelling (BIM)—Versioning for Collaborative Design | 64 |
| A. Jaly Zada, W. Tizani, and A. H. Oti | |
| Government's Influence on the Implementation of BIM | 65 |
| Lucy Atkinson, Joseph Amoako-Attah, and Ali B-Jahromi | |
| Towards Interoperability in the UK Construction Design Industry | 66 |
| Mehdi Bavafa | |
| | |
| BIM—Design and Engineering Knowledge Management | |
| Regulatory Knowledge Encoding Guidelines for Automated Compliance Audit of Building | 67 |
| g, | 07 |
| Engineering Design | O1 |
| | o, |
| Engineering Design | 68 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor | |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment | |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa | 68 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners | 68 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa | 68 69 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for | 68 69 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources | 68 69 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci | 68 69 70 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases | 68 69 70 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases J. Beetz | 68 69 70 71 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases J. Beetz Development of BIM Model Fitness Review System for Modelling Quality Control | 68 69 70 71 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases J. Beetz Development of BIM Model Fitness Review System for Modelling Quality Control | 68 69 70 71 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases J. Beetz Development of BIM Model Fitness Review System for Modelling Quality Control Jun Wang, Xiangyu Wang, Wenchi Shou, Jun Guo, and Lei Hou | 68 69 70 71 |
| Engineering Design Johannes Dimyadi, Charles Clifton, Michael Spearpoint, and Robert Amor Human Library for Emergency Evacuation in BIM-Based Serious Game Environment Rui Liu, Jing Du, and Raja R. A. Issa Framework for Evaluating the BIM Competencies of Building Owners B. Giel and R. R. A. Issa Challenges Associated with Generating Accurate As-Is Building Information Models for Existing Buildings by Leveraging Heterogeneous Data Sources Bo Gu, Semiha Ergan, and Burcu Akinci A Scalable Network of Concept Libraries Using Distributed Graph Databases J. Beetz Development of BIM Model Fitness Review System for Modelling Quality Control Jun Wang, Xiangyu Wang, Wenchi Shou, Jun Guo, and Lei Hou BIM—Building Simulation and Analysis | 68 69 70 71 72 |

| Applying RS and GIS to Study the Impacts of Urban Regeneration on Thermal | 74 |
|------------------------------------------------------------------------------------------|----|
| Environment in Built-Up Areas: A Case Study of Kowloon, Hong Kong | |
| Jin Yeu Tsou, Ming Chun Chao, Xiang Li, and Ke Chen | |
| Interoperability Map between BIM and BPS Software | 75 |
| Danny Alfredo Lobos Calquin, Gerth Wandersleben, and Lorena Silva Castillo | |
| Using Building Performance Information in the Design of Floor Plans | 76 |
| Danny Alfredo Lobos Calquin and Maureen Trebilcock | |
| Framework for Interoperability of Information Resources in the Building Energy | 77 |
| Simulation Domain | |
| G. Gudnason, P. Katranuschkov, C. Balaras, and R. J. Scherer | |
| Extending BIM for Energy Simulation and Design Tasks | 78 |
| P. Katranuschkov, R. J. Scherer, M. Weise, and T. Liebich | |
| BIM—ICT in FM | |
| Towards a Formal Approach for Determining Functions of HVAC Components | 79 |
| Represented in IFC | |
| Xue Yang and Semiha Ergan | |
| INNOVance: Italian BIM Database for Construction Process Management | 80 |
| A. Pavan, B. Daniotti, F. Re Cecconi, S. Maltese, Sonia Lupica Spagnolo, Vittorio Caffi, | |
| Maria Chiozzi, and Daniela Pasini | |
| Utilizing BIM for Real-Time Visualization and Indoor Localization of Resources | 81 |
| A. Costin and J. Teizer | |
| Collaborative BIM-Based Markerless Mixed Reality Framework for Facilities Maintenance | 82 |
| Khaled El Ammari and Amin Hammad | |
| Challenges in the Implementation of BIM for FM—Case Manchester Town Hall Complex | 83 |
| Arto Kiviniemi and Ricardo Codinhoto | |
| Processes and Standards for BIM Closeout Information Deliverables for Owners | 84 |
| Glenda Mayo and Raja R. A. Issa | |
| Visualization and Simulation | |
| Congestion Analysis for Construction Site Layout Planning using Real-Time Data and | 85 |
| Cell-Based Simulation Model | |
| N. Pradhananga and J. Teizer | |
| An Architecture for Reviewing Conducted Collaborative Operational Strategies and | 86 |
| Exploring Alternatives in Virtual Environments: The Case of Asphalt Compaction | |
| A. Vasenev, T. Hartmann, and A. G. Dorée | |
| Characterizing Strategies of Fixing Full-Scale Models in Construction Photogrammetric | 87 |
| Surveying | |
| Ryan Hough and Fei Dai | |

| Simulation-Based Analysis of Surface Jobsite Logistics in Mechanized Tunneling | 88 |
|--------------------------------------------------------------------------------------------|-----|
| Markus Scheffer, Tobias Rahm, and Markus König | |
| A Stakeholder Planning Support System for District Heating Systems | 89 |
| Tim David Johansson and Thomas Olofsson | |
| A BIM-Enabled Approach for Construction Inspection | 90 |
| Yuan-Hao Tsai, Shang-Hsien Hsieh, and Shih-Chung Kang | |
| Key Nodes Modeling for Object Detection and Location on Construction Site using Color- | 91 |
| Depth Cameras | |
| Chenxi Yuan and Hubo Cai | |
| Research on Synchronized Multi-Site Scheduling Using 5-D Building Information | 92 |
| Modeling Technique | |
| Shuhei Tazawa, Kazuya Shide, Norihito Goto, Hirotake Kanisawa, Masato Urae, and Masao Ando | |
| Automated Generation of Construction Sequences using Building Information Models | 93 |
| E. Tauscher, K. Smarsly, M. König, and K. Beucke | |
| Technology Adoption and Management Innovation in Construction | 94 |
| J. Jupp | |
| Tunnel Lining with Corrugated FRP Sheets | 95 |
| T. Hara | |
| Evaluations of BIM: Frameworks and Perspectives | 96 |
| M. P. Nepal, J. R. Jupp, and A. A. Aibinu | |
| Virtual and Augmented Reality | |
| 4D Site Installation Planning in Virtual Reality for Multi-user | 97 |
| Sebastian Hollermann and Hans-Joachim Bargstädt | |
| BIM Navigation with Hand-Based Gesture Control on Sites | 98 |
| Chao-Chung Yang and Shih-Chung Kang | |
| Avatar-Model Interaction in Virtual Worlds Improves Distributed Team Collaboration | 99 |
| through Issue Discovery | |
| Anne Anderson and Carrie Sturts Dossick | |
| Virtual Reality to Support the Integrated Design Process: A Retrofit Case Study | 100 |
| Yifan Liu, Jennifer Lather, and John Messner | |
| Challenges and Trends of Implementation of 3D Point Cloud Technologies in Building | 101 |
| Information Modeling (BIM): Case Studies | |
| T. Qu, J. Coco, M. Rönnäng, and W. Sun | |
| Health and Safety Visualization in Steel Construction Projects through Image Processing | 102 |
| Rula Sharqi and Ammar Kaka | |
| Developing a Mobile Visualization Environment for Construction Applications | 103 |
| Maxwell Parfitt and Jennifer Whyte | |

| Sensemaking and Organizational Boundaries—Aspects in Introducing Virtual Reality for | 104 |
|---------------------------------------------------------------------------------------|-----|
| Inter-Organizational Collaboration | |
| K. Suneson | |
| Rapid Image-Based Localization using Clustered 3D Point Cloud Models with Geo- | 105 |
| Location Data for AEC/FM Mobile Augmented Reality Applications | |
| Hyojoon Bae, Mani Golparvar-Fard, and Jules White | |
| Locating Building Components in a Facility Using Augmented Reality vs. Paper-Based | 106 |
| Methods: A User-Centered Experimental Comparison | |
| M. Gheisari, G. Williams, B. N. Walker, and J. Irizarry | |
| Video-Based Detection and Classification of US Traffic Signs and Mile Markers using | 107 |
| Color Candidate Extraction and Feature-Based Recognition | |
| Vahid Balali and Mani Golparvar-Fard | |
| Virtual Reality in City Planning—A Longitudinal Study | 108 |
| K. Suneson | |
| Automated Approaches in Construction | |
| Data Collection System for a Rapid Recovery Work: Using Digital Photogrammetry and a | 109 |
| Small Unmanned Aerial Vehicle (UAV) | |
| Tsuyoshi Yamamoto, Hiroshi Kusumoto, and Katsuhisa Banjo | |
| Distributed Decision-Making for Real-Time In-Building Evacuation Guidance | 110 |
| Albert Y. Chen and Chuan-Heng Lin | |
| ByggNett (BuildNetwork)—Norwegian Project for Web-Based Collaboration between | 111 |
| Public Authorities and the Construction Industry | |
| Eilif Hjelseth | |
| Time-Quality Analysis of Spatial Data Processing for Bridge Management | 112 |
| Pingbo Tang and Zhenglai Shen | |
| Usability of Pictograms as an Automated Information Input Mechanism In Graphic User | 113 |
| Interface (GUI) for Mobile Computing Devices on Construction Sites | |
| T. Qu, P. H. Jones, and W. Sun | |
| Climate Responsive Automatic Operation Strategies for Double Skin Façade (DSF) | 114 |
| System of High-Rise Buildings | |
| J. Ock, R. R. A. Issa, and S. Olbina | |
| On the Edge of Human Computation: Interactive Parametric Estimating Paradigm | 115 |
| Jing Du and Rui Liu | |
| An Approach to Describe Arbitrary Transition Curves in an IFC-Based Alignment Product | 116 |
| Data Model | |
| J. Amann, M. Flurl, J. R. Jubierre, and A. Borrmann | |
| A Scale, Rotation, and Affine Invariant Line Detection and Matching Algorithm for 3D | 117 |
| Reconstruction of Infrastructure | |
| H. Fathi and I. Brilakis | |

| Full-Scale Application of a Dimensional Quality Assessment Technique to Precast | 118 |
|---------------------------------------------------------------------------------------|-----|
| Concrete Panels using Terrestrial Laser Scanning | |
| M. K. Kim, J. W. Park, H. Sohn, and C. C. Chang | |
| Automated In-Placed Brick Counting for Façade Construction Progress Estimation | 119 |
| Linda Hui, Manwoo Park, and Ioannis Brilakis | |
| Automated Cleaning of Point Clouds for Highway Retaining Wall Condition Assessment | 120 |
| Pedram Oskouie, Burcin Becerik-Gerber, and Lucio Soibelman | |
| Theoretical Base of the Building to Models of Management in Construction | 121 |
| F. Klashanov | |
| Automatic Fall Risk Identification Using Point Cloud Data in Construction Excavation | 122 |
| Jun Wang, Nipesh Pradhananga, and Jochen Teizer | |
| Predictive Assessment and Proactive Monitoring of Struck-By Safety Hazards in | 123 |
| Construction Sites: An Information Space Approach | |
| Leonardo Bobadilla, Ali Mostafavi, Triana Carmenate, and Sulabh Bista | |
| The Validation of Gait-Stability Metrics to Assess Construction Workers' Fall Risk | 124 |
| Houtan Jebelli, Changbum R. Ahn, and Terry L. Stentz | |
| Dynamic Biomechanical Analysis for Construction Tasks Using Motion Data from Vision- | 125 |
| Based Motion Capture Approaches | |
| Joon Oh Seo, Richmond Starbuck, SangUk Han, Sang Hyun Lee, and Thomas J. | |
| Armstrong | |
| On-Site Safety Management Using Image Processing and Fuzzy Inference | 126 |
| Hongjo Kim, Bakri Elhamim, Hoyoung Jeong, Changyoon Kim, and Hyoungkwan Kim | |
| Case Studies for the Planning and Monitoring of Unit- and Fixed-Price Contracts Using | 127 |
| Project Scheduling Software | |
| A. Francis and E. Miresco | |
| Cloud-Based Interactive Probabilistic Simulation for AEC Industry | 128 |
| Jing Du, Rui Liu, and Yilmaz Hatipkarasulu | |
| Field Use of Physiological Status Monitoring (PSM) to Identify Construction Workers' | 129 |
| Physiologically Acceptable Bounds and Heart Rate Zones | |
| Wonil Lee and Giovanni C. Migliaccio | |
| Resource-Based Multi-Method Simulation Model for Super-Tall Building Construction | 130 |
| M. Jung, M. Park, H. Lee, and B. Lee | |
| Performance Tests for Automatic 3D Geometric Data Registration Technique for | 131 |
| Progressive As-Built Construction Site Modeling | |
| C. Wang, Y. K. Cho, and J. W. Park | |
| Developing Products in Product Platforms in the AEC Industry | 132 |
| P. Jensen, T. Olofsson, E. Smiding, and R. Gerth | |

| Automated A | Approaches | in Construction— | Sensing |
|-------------|-------------------|------------------|---------|
|-------------|-------------------|------------------|---------|

N. O. Nawari

| Taxonomy of Work Spaces for Sensor-Driven Jobsite Management | 133 |
|-----------------------------------------------------------------------------------------|-----|
| Mohsin K. Siddiqui | |
| Device-Free Detection to Improve Construction Work Health and Safety | 134 |
| R. Edirisinghe, H. Lingard, N. Blismas, D. Dias, and R. Wakefield | |
| Experimental Investigation of Chirp Spread Spectrum-Based Swarm Sensors for | 135 |
| Construction Resource Tracking | |
| A. A. Akanmu and C. J. Anumba | |
| A Stereo Vision-Based Approach to Marker-Less Motion Capture for On-Site Kinematic | 136 |
| Modeling of Construction Worker Tasks | |
| Richmond Starbuck, JoonOh Seo, SangUk Han, and SangHyun Lee | |
| Utilizing Field Data Capture Technologies for Monitoring Activities in Double-Shift | 137 |
| Construction Projects | |
| G. Guven and E. Ergen | |
| Detecting the Hazards of Lifting and Carrying in Construction through a Coupled 3D | 138 |
| Sensing and IMUs Sensing System | |
| J. Chen, C. R. Ahn, and S. Han | |
| Sensor Networks | |
| Computer Simulations of the Vehicle Localization for Intelligent Transportation Systems | 139 |
| Arghavan Amini and Jesus M. de la Garza | |
| Programming Module for Making Report in Bridge Loading Test | 140 |
| Chang. A Haocheng, Jianming Lu, Huaijian Li, Jianyong Song, Ke Chen, and An Zhao | |
| A Study of the Framework on Collision Risk Warning System Using Loop Detector and | 141 |
| Vehicle Information | |
| Sehyun Tak, Soomin Woo, and Hwasoo Yeo | |
| A Data Collection and Analysis Framework to Improve the Performance of Energy- | 142 |
| Intensive Commercial Buildings | |
| Elie Azar, Carol C. Menassa, and | |
| Building Energy Benchmarking with Building Information Modeling and Wireless Sensor | 143 |
| Technologies for Building Retrofits | |
| Jeong-Han Woo and Blake Gleason | |
| Fundamental Test of Seismic Information and Building Damage Data Gathering System | 144 |
| using OSHW with Wireless Sensor Network | |
| Yuichiro Yamabe, Hiroto Sasaki, Tatsuya Inatome, and Akinori Tani | |
| Civil and Structural Design and Analysis | |
| BIM Standard: Tensile Structures Data Modeling | 145 |

| Wind-Induced Dynamic Analysis of the Arched Tensegrity Structures in Time Domain | 146 |
|------------------------------------------------------------------------------------|-----|
| Chengjiang Lu, Shunan Lu, and Xiaodong Wang | |
| Regional Seismic Damage Prediction Based on High-Performance GPU Computing: A | 147 |
| Case Study of Tsinghua University Campus | |
| Zhen Xu, Xinzheng Lu, Bo Han, Chen Xiong, and Aizhu Ren | |
| Multi-Layer Shell Element for Shear Walls in OpenSees | 148 |
| Linlin Xie, Xiao Lu, Xinzheng Lu, Yuli Huang, and Lieping Ye | |
| Investigation on the Effects of Environmental and Operational Conditions (EOC) on | 149 |
| Diffuse-Field Ultrasonic Guided-Waves in Pipes | |
| M. Eybpoosh, M. Berges, and H. Y. Noh | |
| Evaluation of Stereo Matching Algorithms for Temporary Structure Monitoring | 150 |
| Youyi Feng and Fei Dai | |
| Thermal Simulation of Hydration Heat in Slab of Taishan Nuclear Power Plant Unit 2 | 151 |
| Feng Qin, Feng Fan, Zheng Li, Hongliang Qian, and Xiaofei Jin | |
| Comparison of Machine Learning Techniques for Developing Performance Prediction | 152 |
| Models | |
| Nima Kargah-Ostadi | |
| Rainfall Thresholds and Flood Warnings: A Case Study in New Taipei City | 153 |
| Er-Xuan Sung, Meng-Han Tsai, and Shih-Chung Kang | |
| The Computational Generation and Realization of Spatial Truss Structures | 154 |
| X. Z. Zhao, R. H. Wang, and K. Shea | |
| Agent-Based Model Architecture for Mesoscopic Traffic Simulations | 155 |
| Tanaphat Jeerangsuwan and Amr Kandil | |
| Assessing the Performance of the Non-Dominated Sorting Genetic Algorithm in | 156 |
| Optimizing Construction Site Planning | |
| A. M. Khalafallah | |
| Experiment Investigation and Numerical Analysis on the Low-Yield-Point Steel Shear | 157 |
| Panel Dampers | |
| Li-Yan Xu, Jian-Guo Nie, and Jian-Sheng Fan | |
| Predicting the Behaviour of Reinforced Concrete Elements Strengthened with CFRP | 158 |
| Using Model Updating Techniques | |
| Yaqub M. Y. Rafiq and M. Al-Farttoosi | |
| Finite Element Analyses of Double-Wall Sandwich Structures with Viscoelastic Core | 159 |
| Rawad Assaf and Walid Larbi | |
| Tubular Steel Truss Design Using Semi-Rigid Joints | 160 |
| Teemu Tiainen and Markku Heinisuo | |
| Development of a Steel Beam Hauling System for Automatic Steel Beam Assembly | 161 |
| Ci-Jyun Liang and Shih-Chung Kang | |
| | |

| Effect of Corner Radius on Confinement Effectiveness of GFRP and Lateral Ties | 162 |
|------------------------------------------------------------------------------------------|-----|
| Confined Polyolefin Fibre Reinforced Concrete Prisms under Monotonic Axial | |
| Compression | |
| S. Palanivel, M. Sekar, and N. Subramanian | |
| Nonlinear Full-Process Shear Analysis of RC Structural Members Using Planar | 163 |
| Membrane Element: Implementation and Application | |
| Meng Zhou, Jian-Guo Nie, and Jian-Sheng Fan | |
| An Algorithm for the Probabilistic Risk Calculation of Dropped Objects: Application of | 164 |
| the Pipeline Protection System of Offshore Platforms | |
| Yeong Ae Heo, Thomas HK. Kang, and Sashi Kunnath | |
| Design of a Versatile Engineering Simulation Environment for Coupled Continuous- | 165 |
| Discontinuous Simulation | |
| Wei-Tze Chang, Ren-Zuo Wang, Shang-Hsien Hsieh, Chung-Yue Wang, and Kuo-Chun | |
| Chang | |
| Integrated Assessment of the Technical Condition of the Housing Projects on the Basis | 166 |
| of Computer Technology | |
| V. V. Garyaeva and N. A. Garyaev | |
| Re-Using Engineering Tools: Engineering SaaS Web Application Framework | 167 |
| R. Klinc, I. Peruš, and M. Dolenc | |
| Integrated Design and Construction Planning of a High-Rise Residential Building | 168 |
| Camille A. Issa and Anthony El-Hachem | |
| 4D Multi-Scale Analysis of the Hybrid Zone for Cable-Stayed Bridges with Steel-Concrete | 169 |
| Hybrid Girders | |
| Meng Zhou, Xiao-Xv Ning, Jian-Sheng Fan, Jian-Guo Nie, and Xiao-Gang Yang | |
| Analysis of Foundation of Tall RC Chimney with 3D Finite Element Method | 170 |
| S. V. Jisha, B. R. Jayalekshmi, and R. Shivashankar | |
| Optimization of Highway Geometric Design Process for Computer-Based Design Koji Makanae | 171 |
| Cloud-Computing Based Parameter Identification System—with Applications in | 172 |
| Geotechnical Engineering | 172 |
| Y. M. Hsieh | |
| A Web-Based Architecture for Interactive Finite Element Program | 173 |
| F. Hejazi, M. Shahpasand, M. Mirnezhad, M. S. Jaafar, and A. A. Abang Ali | 173 |
| Seismic Performance Evaluation of Steel Shear Wall by Equivalent Truss Approach | 174 |
| Modeling | .,4 |
| A. Fateh, F. Hejazi, and M. R. Khojasteh | |
| A. Laton, L. Hojazi, and M. Lt. Miojaston | |

Collaborative Design and Engineering

| Global Teamwork: The Influence of Multiculturalism on Project Product and Process | 175 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Success | |
| Maria Frank and Renate Fruchter | |
| Solving Ready-Mixed Concrete Delivery Problems: Evolutionary Comparison between | 176 |
| Column Generation and Robust Genetic Algorithm | |
| Mojtaba Maghrebi, Vivek Periaraj, S. Travis Waller, and Claude Sammut | |
| Transformative 3D Immersive Collaboration Environment in Support of AEC Global | 177 |
| Teamwork | |
| Renate Fruchter | |
| The Adaptation and Application of an ICT-Supported Collaboration Model: A Case Study | 178 |
| in a Public Sector Construction Project Department | |
| E. L. do Nascimento, S. Scheer, and M. C. D. Freitas | |
| Critical Success Factors (CSFs) of BIM Implementation for Collaboration based on | 179 |
| System Analysis | |
| Zhexiong Shang and Zhigang Shen | |
| Root Cause Analysis Towards Lean Collaboration Between Production Line and Factory | 180 |
| Planning | |
| Svetlana Slitnikova and Renate Fruchter | |
| | |
| | |
| Design and Engineering Knowledge Management | |
| Design and Engineering Knowledge Management Planning and Scheduling Prefabrication Construction Projects Using Dependency | 181 |
| | 181 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency | 181 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) | 181 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood | |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to | |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study | |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci | 182 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction | 182 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu | 182 183 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building | 182 183 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building Envelope Components During an Energy Retrofit Project—A Comparative Case Study | 182 183 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building Envelope Components During an Energy Retrofit Project—A Comparative Case Study Miguel Moral, Burcu Akinci, and Mario Berges | 182 183 184 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building Envelope Components During an Energy Retrofit Project—A Comparative Case Study Miguel Moral, Burcu Akinci, and Mario Berges A Study on Effective Construction Management Utilising Civil Information Modeling/ | 182 183 184 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building Envelope Components During an Energy Retrofit Project—A Comparative Case Study Miguel Moral, Burcu Akinci, and Mario Berges A Study on Effective Construction Management Utilising Civil Information Modeling/ Management (CIM) | 182 183 184 |
| Planning and Scheduling Prefabrication Construction Projects Using Dependency Structure Matrix (DSM) Yuanxin Zhang and Ian Flood Challenges in Interpreting the Design Intent from HVAC Sequence of Operations to Assess the System Behavior: A Case Study Raghuram Sunnam, Semiha Ergan, and Burcu Akinci Platform Concepts in Bridge Construction Johan Larsson, Thomas Olofsson, and Weizhuo Lu Information Exchange Requirements to Support Commissioning of HVAC and Building Envelope Components During an Energy Retrofit Project—A Comparative Case Study Miguel Moral, Burcu Akinci, and Mario Berges A Study on Effective Construction Management Utilising Civil Information Modeling/ Management (CIM) Nobuyuki Suzuki, Junjiro Akiba, and James R. Whorlow | 182 183 184 |

Building Sciences

| Modeling Impact of Sustainability Policies in Qatar using Agent Based Approach and Life | 187 |
|-----------------------------------------------------------------------------------------|-----|
| Cycle Analysis | |
| S. Attallah, A. Kandil, A. Senoucy, H. Alderham, and E. Elwakil | |
| A Framework of Cloud-Computing-Based BIM Service for Building Lifecycle | 188 |
| J. P. Zhang, Q. Liu, F. Q. Yu, Z. Z. Hu, and W. Z. Zhao | |
| Aligning BIM and Lean Methodologies within the Capital Works Management Framework | 189 |
| in Ireland | |
| Muiris O'Loingsigh, Alan Hore, Barry McAuley, and John Deeney | |
| Project Management Performance in the UAE Construction Industry | 190 |
| A. Al-Hajj and A. Sayers | |
| Assessing the Significance of Mismatching in Buildings' Final Drawings in Dubai | 191 |
| Projects | |
| M. F. Shamkhi and A. Al-Hajj | |
| Modeling Sustainable Building Materials in Saudi Arabia | 192 |
| Mohamed Marzouk, Mahmoud Metawie, Mohamed Hisham, Ibrahim Al-Sulahi, Mohab | |
| Kamal, and Khalid Al-Gahtani | |
| Measuring Thermal Mass of Sustainable Concrete Mixes | 193 |
| O. Damdelen, C. Georgopoulos, and M. C. Limbachiya | |
| Intelligent Systems | |
| A Video-Enabled Dynamic Site Planner | 194 |
| Chin-Wei Liu and Shih-Chung Kang | |
| Augmented Reality and Unmanned Aerial Vehicle Assist in Construction Management | 195 |
| Ming-Chang Wen and Shih-Chung Kang | |
| Geographically Distributed Learning Network Construction Industry | 196 |
| N. A. Garyaev | |
| Massive Online Geo-Social Networking Platforms and Urban Human Mobility Patterns: A | 197 |
| Process Map for Data Collection | |
| Q. Wang and J. E. Taylor | |
| Unsupervised Framework for Traffic Counting: Speed Estimation Based on Camera | 198 |
| Network Data | |
| MW. Park, E. Palinginis, I. Brilakis, J. Laval, M. Hunter, and R. Guensler | |
| Assessing Energy Improvement Potential from Efficiency and Renewable Interventions at | 199 |
| Neighborhood Level | |
| A Mhalas T Croshie N Dawood and M Kassem | |

Decision Support Systems

| Application of the Bid Amount Model to Cost Estimation Systems for Public Works | 200 |
|---------------------------------------------------------------------------------------|-----|
| Satoru Yamaki and Nobuyoshi Yabuki | |
| Computer-Aided Zoning and Urban Planning | 201 |
| P. N. Garyaev | |
| Enhancing the Credibility of Agent-Based Model for the Study of Workers' Group | 202 |
| Behavior by Comparing Simulation Data with Survey Data | |
| Seungjun Ahn and SangHyun Lee | |
| A GIS-Based Demand Forecast Using Machine Learning for Emergency Medical Services | 203 |
| Albert Y. Chen and Tsung-Yu Lu | |
| A Multi-Objective Decision Support System for Selecting Dispute Resolution Methods in | 204 |
| the Construction Industry | |
| Mostafa Babaeian Jelodar, Tak Wing Yiu, and Suzanne Wilkinson | |
| Multi-Criteria Decision Making for the Design of Building Facade | 205 |
| Benny Raphael | |
| Building Simulation and Analysis | |
| Influence of Properties of the Room on Parameters of Regulators of the Automated | 206 |
| Climatic Systems | |
| Oleg D. Samarin, Irina I. Tishchenkova, and Igor' I. Goryunov | |
| Knowledge-Based Holistic Energy Management of Public Buildings | 207 |
| S. K. Howell, Y. Rezgui, and B. Yuce | |
| Towards Data-Driven Energy Consumption Forecasting of Multi-Family Residential | 208 |
| Buildings: Feature Selection via The Lasso | |
| R. K. Jain, T. Damoulas, and C. E. Kontokosta | |
| Cross-Case Energy Simulation Modeling Analysis in Healthcare Facilities Retrofit | 209 |
| Atefeh Mohammadpour, Ibrahim Alanqar, Chimay Anumba, and John Messner | |
| Evaluating Energy Loss through Recessed Lighting Fixtures (RLF) in Residential | 210 |
| Buildings through a Case Study | |
| Ri Na, Shengmao Lin, Zhigang Shen, and Linxia Gu | |
| Maintenance, Retrofit and Operation Decision Support Tool for Both Domestic and Non- | 211 |
| Domestic Buildings | |
| F. Fouchal, T. M. Hassan, and S. K. Firth | |
| Infrastructure Monitoring and Maintenance | |
| The Use of Cyber-Physical Systems in Temporary Structures—An Exploratory Study | 212 |
| Xiao Yuan, M. Kevin Parfitt, and Chimay J. Anumba | |

| A Review of Field Implementation of Infrared Thermography as a Non-Destructive | 213 |
|------------------------------------------------------------------------------------------|-----|
| Evaluation Technology | |
| Shuhei Hiasa, Recep Birgul, Azusa Watase, Masato Matsumoto, Koji Mitani, and F. | |
| Necati Catbas | |
| Detecting Location of Construction Defects in Drilled Shafts Using Frequency | 214 |
| Tomography Analysis of Cross-Hole Sonic Logging | |
| Caesar Abishdid and Masood Hajali | |
| Resiliency of Intelligent Transportation Systems to Critical Disruptions: An Eigenvalue- | 215 |
| Based Viewpoint | |
| Seyed Hosseini Hosseini Nourzad and Anu Pradhan | |
| Estimating Potential Cost Savings from Implementing an Innovative TBM Guidance | 216 |
| Automation System | |
| Ming Lu, Xuesong Shen, and Sheng Mao | |
| Research on Mechanism of Overturning Failure for Single-Column Pier Bridge | 217 |
| Weibing Peng, Fei Dai, and Ertugrul Taciroglu | |
| Development and Applications of a Total Station with a Built-in Crack Scale | 218 |
| Kazuhide Nakaniwa, Nobuyoshi Yabuki, Daisuke Nishi, Koji Mitani, and Masato | |
| Matsumoto | |
| Disaster Information Sharing System Using Open Source Web GIS | 219 |
| Satoshi Kubota, Kazuyasu Matsumura, Sadao Yano, Tatsuya Kitadani, Ikuo Kitagawa, | |
| and Akiyoshi Ichiuji | |
| Anomaly Detection on Piezometer Data Collected from Embankment Dams Using | 220 |
| Physical Model-Based Simulation | |
| In-Soo Jung, Mario Berges, and James H. Garrett Jr | |
| Life-Cycle Cost Assessment for Bridge Management: An Application to Nebraska Bridges | 221 |
| Afshin Hatami and George Morcous | |
| Masonry Crack Detection Application of an Unmanned Aerial Vehicle | 222 |
| A. Ellenberg, A. Kontsos, I. Bartoli, and A. Pradhan | |
| Automated Detection of Damaged Areas after Hurricane Sandy using Aerial Color Images | 223 |
| Shi Ye, Seyed Hossein Hosseini Nourzad, Anu Pradhan, Ivan Bartoli, and Antonios | |
| Kontsos | |
| A Study on the Asset Management of Japan Road Bridges for the Future—Plan for the | 224 |
| Low Cost Maintenance with New System and IT Means | |
| Yasushi Kawanai | |
| Seismic Reliability Assessment of Lifeline Systems | 225 |
| S. E. Christodoulou and M. Fragiadakis | |
| Exploratory Study Towards Streamlining the Identification of Sensor Locations Within a | 226 |
| Facility | |

Burcu Akinci, Mario Berges, and Alejandro Gomez Rivera

| An Agent-Based Framework for Occupant-Oriented Intelligent Facility Management | 227 |
|----------------------------------------------------------------------------------------------|-----|
| Scheduling | |
| Yang Cao, Xinyi Song, and Xuan Jiang | |
| Evaluating Current Systems and Exploring the Potential of Social Networking Platforms | 228 |
| to Increase User Engagement with Eco-Feedback Systems | |
| N. Mohammadi, T. Bulbul, and J. E. Taylor | |
| Information Technologies in Management of Listed Buildings | 229 |
| S. G. Sheina and L. L. Babenko | |
| Intelligent Systems | |
| Development and Key Technology of Digital Line Selection System of Urban Rail Transit | 230 |
| (URT) | |
| Cunxi Meng, Chao Huang, and Yaxin Meng | |
| Real-Time Travel Time Prediction Using Multi-Level k-Nearest Neighbor Algorithm and | 231 |
| Data Fusion Method | |
| Sehyun Tak, Sunghoon Kim, Kiate Jang, and Hwasoo Yeo | |
| Unsupervised Clustering of Residential Electricity Consumption Measurements for | 232 |
| Facilitated User-Centric Non-Intrusive Load Monitoring | |
| F. Jazizadeh, B. Becerik-Gerber, M. Berges, and L. Soibelman | |
| System-of-Systems Modeling of Performance in Complex Construction Projects: A Multi- | 233 |
| Method Simulation Paradigm | |
| Jin Zhu, Ali Mostafavi, and Irtishad Ahmad | |
| Computational Modeling of Driver Distraction by Integrating Cognitive and Agent-Based | 234 |
| Traffic Simulation Models | |
| Seyed Hosseini Hosseini Nourzad, Dario D. Salvucci, and Anu Pradhan | |
| An Agent-Based Evacuation Model to Support Fire Safety Design Based on an Integrated | 235 |
| 3D GIS and BIM Platform | |
| Jianyong Shi and Pai Liu | |
| Sustainable Building and Construction | |
| A Research Study On Lifecycle Infrastructure Management With Shared Product Model | 236 |
| On Collaborative Information Systems | |
| Katsunori Miyamoto | |
| Development of a Decision Support System for LEED for EB Credit Selection Based on | 237 |
| Climate Factors | |
| Jack C. P. Cheng and Jun Ma | |
| Analysis of the Related Credits in LEED Green Building Rating System Using Data Mining | 238 |
| Techniques | |
| Jun Ma and Jack C. P. Cheng | |

| Probabilistic Life Cycle Cost Model for Sustainable Housing Retrofit Decision-Making | 239 |
|----------------------------------------------------------------------------------------|-----|
| A. Jafari, V. Valentin, and M. Russell | |
| Using Accrual Accounting Life Cycle Assessment as an Indicator of Urban Sustainability | 240 |
| Mostafa Batouli and Yimin Zhu | |
| An Evaluation of Life Cycle Analysis (LCA) Tools for Environmental Impact Analysis of | 241 |
| Building End-of-Life Cycle Operations | |
| Behzad Hamidi and Tanyel Bulbul | |
| A Framework of Green Growth Assessment for Thailand's Highway Infrastructure | 242 |
| Developments | |
| N. Kokkaew and J. Rudjanakanoknad | |
| Framework for Sustainable Low-Income Housing Projects in Egypt | 243 |
| Mohammed Marzouk and Mahmoud Metawie | |
| BIM in Sustainable Design: Strategies for Retrofitting/Renovation | 244 |
| R. Hammond, N. O. Nawari, and B. Walters | |
| The Process of Adapting a Sustainable Building Assessment Method Worldwide: SEAM, | 245 |
| A Case Study | |
| Saleh H. Alyami, Yacine Rezgui, and Ian Kwan | |
| Energy Consumption Patterns for Domestic Buildings in Hot Climates Using Saudi | 246 |
| Arabia as Case Study Field: Multiple Case Study Analyses | |
| Naief A. Aldossary, Yacine Rezgui, and Alan Kwan | |
| Benchmarking Building Energy Performance Using Data Envelopment Analysis with | 247 |
| Normalized Metrics—A Residential Case Study | |
| E. Wang, Z. Shen, L. Wang, and N. Barry | |
| Co-Design of a Technological Solution for the Promotion of Eco-Responsible Behaviors | 248 |
| in Family Homes | |
| Régis Decorme, Alain Zarli, Fabio Carnevale Maffe, and Franck Debos | |
| Application of Monte Carlo Simulation and Optimization to Multi-Objective Analysis of | 249 |
| Sustainable Building Designs | |
| Peeraya Inyim and Yimin Zhu | |
| Some Aspects of the Application of Cloud Services in Calculating the Energy | 250 |
| Consumption of Buildings | |
| E. N. Kulikova and L. V. Sukneva | |
| Design Decision Support—Real-Time Energy Simulation in the Early Design Stages | 251 |
| F. Ritter, G. Schubert, P. Geyer, A. Borrmann, and F. Petzold | |
| Modeling Thermostatically Controlled Loads to Engage Households in the Smart Grid: | 252 |
| Lessons Learned from Residential Refrigeration Units | |
| E. C. Kara, M. Bergés, and G. Hug | |
| Maximizing Occupants' Comfort in Affordable Housing Units | 253 |
| Aslihan Karatas and Khaled El-Rayes | |

Education and Training

| Sustainability Challenges in Civil Engineering Education | 254 |
|---------------------------------------------------------------------------------------|-----|
| A. I. Osofero, C. Udeaja, M. Corradi, and T. Vo | |
| Serious Games for the Learning and Practices of Hazard Recognition: Understanding the | 255 |
| Design Complexity for 3D Construction Site Modeling | |
| Wonil Lee, Ting-Hui Lin, Fadi Castronovo, and Ken-Yu Lin | |
| Automated Deviation Analysis for As-Built Status Assessment of Steel Assemblies and | 256 |
| Pipe Spools | |
| M. Nahangi, J. Yeung, J. Amaral, F. N. Freitas, S. Walbridge, and C. T. Haas | |
| A Multi-User Virtual 3D Training Environment to Advance Collaboration Among Crane | 257 |
| Operator and Ground Personnel in Blind Lifts | |
| Yihai Fang and Jochen Teizer | |
| Enhancing Spatial and Temporal Cognitive Ability in Construction Education Through | 258 |
| Augmented Reality and Artificial Visualizations | |
| Ivan Mutis and Raja R. A. Issa | |
| Combining Serious Games and 4D Modelling for Construction Health and Safety Training | 259 |
| Nashwan Dawood, Geoff Miller, João Patacas, and Mohamad Kassem | |
| Engaging Capability Training in Serious Game Technology for Delivering Industrialized | 260 |
| Construction | |
| R. Ibrahim, A. Rashidi, N. S. Said, and M. S. Othman | |
| An Interactive Steel Connection Teaching Tool—A Virtual Structure | 261 |
| H. Dib, K. Chou, and S. Moaveni | |
| Lessons Learned from Monitoring Electricity Consumption in a Research Lab Through a | 262 |
| Capstone Project Course | |
| Alejandro Gomez Rivera, Sergio Guindon, Timothy Pianka, Neil Patel, Varun Kasireddy, | |
| Enze Li, Juncheng Li, Semiha Ergan, and Mario Berges | |
| An Interactive Virtual Environment to Improve Undergraduate Students' Competence in | 263 |
| Surveying Mathematics | |
| H. Dib and N. Adamo-Villani | |
| Moving an Academic Simulation Closer to a Heavy Construction Industry Tool by Adding | 264 |
| an Equipment Management Module | |
| Thomas M. Korman and Hal Johnston | |
| Use of Video Games to Enhance Construction Management Education | 265 |
| Hamzah Alshanbari and Raja R. A. Issa | |
| Education and Training—BIM | |
| BIM in Structural Design Education | 266 |
| N O Nawari T Chichugova S Mansoor and L Delfin | |

| BIM Education: Implementing and Reviewing "OpeBIM"—BIM for Teachers | 267 |
|------------------------------------------------------------------------------------------|-----|
| Sunil Suwal, Päivi Jäväjä, and Janne Salin | |
| A Tool for Assisting Teachers in Planning BIM Courses | 268 |
| M. B. Barison and E. T. Santos | |
| Teaching and Learning-Based Optimization Algorithm for Optimum Design of Steel | 269 |
| Buildings | |
| I. Aydogdu and A. Akin | |
| Building Information Modeling in Graduate Construction Engineering and Management | 270 |
| Education | |
| Carrie Sturts Dossick, Namhun Lee, and Sean Foleyk | |
| Knowledge Transfer with Technology: Interdisciplinary Team Experiences in Design and | 271 |
| Construction Education | |
| C. Monson and C. S. Dossick | |
| Ontologies and Semantics | |
| A Taxonomy for Building Energy Dashboards | 272 |
| Varun Kumaraswamy, Semiha Ergan, and Burcu Akinci | |
| Technology Ontology and BIM-Enabled Estimating for Owners and Contractors | 273 |
| Marcel Maghiar, Lauren Livingston, and Avi Wiezel | |
| A Social Networking Website for AEC Projects | 274 |
| Mehrdad Niknam and Saeed Karshenas | |
| Evaluation of IFC4 for the GIS and Green Building Domains | 275 |
| Jack C. P. Cheng, Yichuan Deng, Moumita Das, and Chimay Anumba | |
| Mapping Work Process and Information Exchange of Construction Entities for BIM | 276 |
| Implementation: Case Study of an Academic Institute | |
| Veerasak Likhitruangsilp, Photios G. Ioannou, and Sarawuth Leeladejkul | |
| The Formal Language for Describing Technological Processes in Construction | 277 |
| P. B. Kagan and T. A. Barabanova | |
| Ontology-Based, Multi-Label Text Classification for Enhanced Information Retrieval for | 278 |
| Supporting Automated Environmental Compliance Checking | |
| Peng Zhou and Nora El-Gohary | |
| Extending Building Information Models Semi-Automatically Using Semantic Natural | 279 |
| Language Processing Techniques | |
| Jiansong Zhang and Nora M. El-Gohary | |
| Ontology-Based Semantic Modeling of Safety Management Knowledge | 280 |
| Sijie Zhang, Frank Boukamp, and Jochen Teizer | |
| Rule-Based NLP Methodology for Semantic Interpretation of Impact Factors for | 281 |
| Construction Claim Cases | |
| Jia Niu and Raja R. A. Issa | |

Representing SimModel in the Web Ontology Language

P. Pauwels, E. Corry, and J. O'Donnell

An Approach for Identifying and Evaluating Opportunities Offered by Semantic

Technology to BIM-Enabled Online Collaboration Platforms

G. Charalambous, A. Thorpe, P. Demian, S. G. Yeomans, N. Doughty, and C. Peters

Copyright and Disclaimer

ISBN: 978-0-7844-1361-6

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document.

282

283

ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefore. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

Copyright © 2014 by the American Society of Civil Engineers. All Rights Reserved.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

American Society of Civil Engineers
ASCE International Headquarters
1801 Alexander Bell Drive
Reston, VA 20191-4400 USA

Call Toll-Free in the U.S.: 1-800-548-2723 (ASCE)
Call from anywhere in the world: 1-703-295-6300

Internet: http://www.pubs.asce.org

This product was produced for the American Society of Civil Engineers by Omnipress.

Duplication of this product and its content in print or digital form for the purpose of sharing with others is prohibited without permission from the American Society of Civil Engineers.

Photocopies and reprints.

You can obtain instant permission to photocopy ASCE publications by using ASCE's online permission service (www.pubs.asce.org/authors/RightslinkWelcomePage.html). Requests for 100 copies or more should be submitted to the Reprints Department, Publications Division, ASCE, (address above); email: permissions@asce.org. A reprint order form can be found at www.pubs.asce.org/authors/reprints.html.

In no event will ASCE, Omnipress or its suppliers be liable for any consequential or incidental damages to your hardware or other software resulting from the installation and/or use of this product.

No part of the product navigation and "Help" files may be reproduced or used without written permission from Omnipress.

© 2014 Omnipress - All rights reserved.